SURVEY ENGINEERING

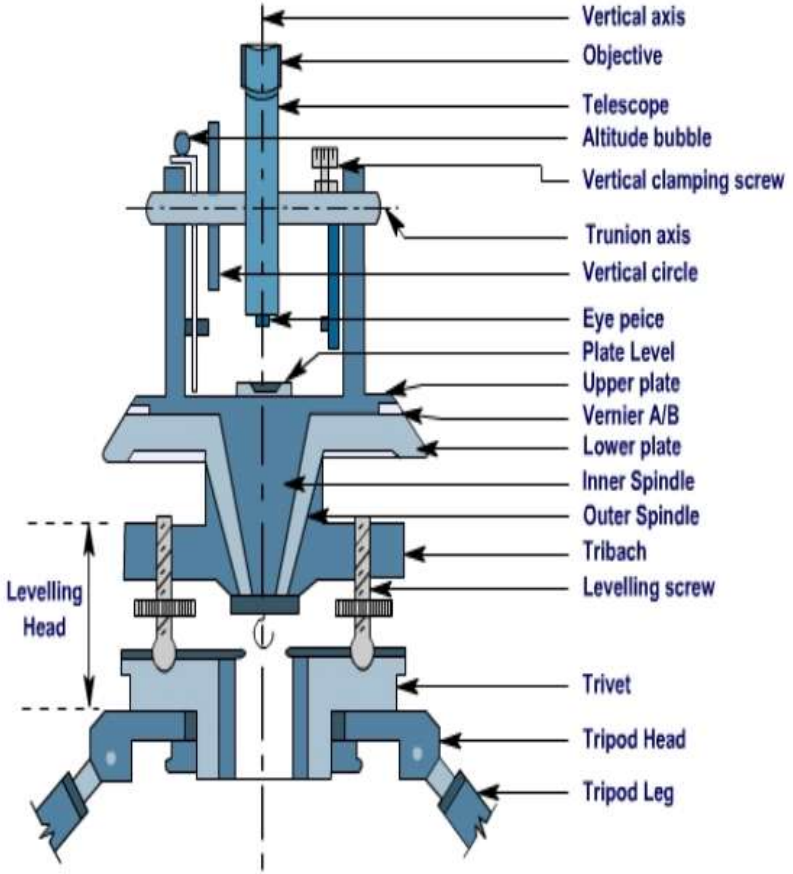
Topic : Theodolite Surveying (Part 1)

Notes

The system of surveying in which the angles are measured with the help of a theodolite, is called Theodolite surveying.

The Theodolite is a most accurate surveying instrument mainly used for :

- Measuring horizontal and vertical angles.
- Locating points on a line.
- Prolonging survey lines.
- Finding difference of level.
- Setting out grades
- Ranging curves
- Tacheometric Survey



CLASSIFICATION OF THEODOLITES :

Theodolites may be classified as :

A. i) Transit Theodolite. ii) Non Transit Theodolite.
B. i) Vernier Theodolites. ii) MicrometerTheodolites.

Transit Theodolite:

These are theodolite which can be reversed by revolving telescope through 180deg. In vertical plane.

Non-Transit Theodolite:

In which line of sight cannot be reversed by revolving telescope through 180 deg. In vertical plane. They are inferior in utility and have now become obsolete.

Vernier Theodolite:

For reading the graduated circle if verniers are used ,the theodolite is called as a Vernier,Theodolite. least count 20 second.

Whereas, if a micrometer is provided to read the graduated circle the same is called as a MicrometerTheodolite/ Optical Theodolite.

SIZE OF THEODOLITE :

A theodolite is designated by diameter of the graduated circle on the lowerplate. The common sizes are 8cm to 12 cm while 14 cm to 25 cminstrument are used for triangulation work.

TRANSIT VERNIER THEODOLITE :

A Transit vernier theodolite essentially consist of the following :

1. Levelling Head.
2. LowerCircular Plate.
3. Upper Plate.
4. Telescope.
5. Vernier Scale.
6. T- Frame.
7. Plumb–bob.
8. Tripod Stand.

Centering :

Centering means setting the theodolite exactly over an instrument- station so that its vertical axis lies immediately above the station- mark. It can be done by means of plumb bob suspended from a small hook attached to the vertical axis of the theodolite.

Transiting :

Transiting is also known as plunging or reversing. It is the process of turning the telescope about its horizontal axis through 180deg. in the vertical plane thus bringing it upside down and making it point , exactly in opposite direction.

Swinging the telescope :

It means turning the telescope about its vertical axis in the horizontal plane. Aswing is called right or left according as the telescope is rotated clockwise or counter clockwise

Face Left :

If the vertical circle of the instrument is on the left side of the observer while taking a reading ,the position is called the face left and the observation taken on the horizontal or vertical circle in this position, is known as the face left observation

Face Right :

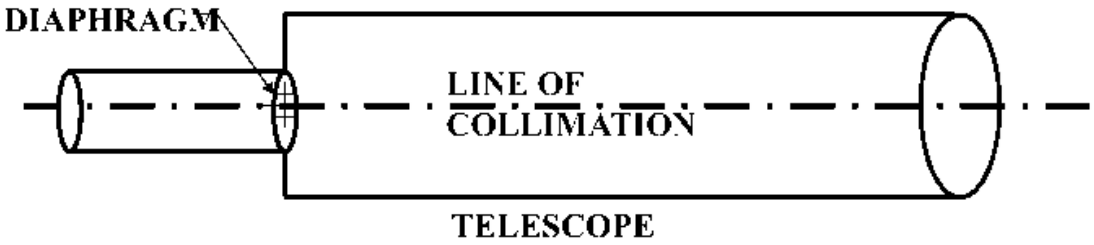
If the vertical circle of the instrument is on the right side of the observer while taking a reading ,the position is called the face right and the observation taken on the horizontal or vertical circle in this position, is known as the face right observation.

Changing Face :

It is the operation of bringing the vertical circle to the right of the observer ,if originally it is to the left , and vice– versa. It is done in two steps; Firstly revolve the telescope through 180 deg. in a vertical plane and then rotate it through 180 deg. in the horizontal plane i.e first transit the telescope and then swing it through 180 deg.

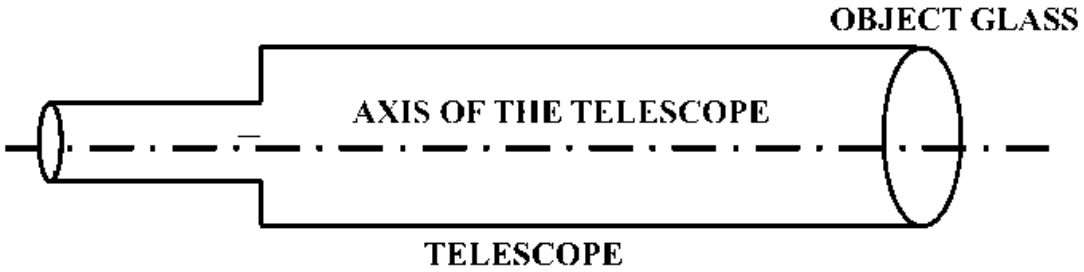
Line of Collimation :

It is also known as the line of sight .It is an imaginary line joining the intersection of the cross- hairs of the diaphragm to the optical centre of the object- glass and its continuation.



Axis of the telescope :

It is also known an imaginary line joining the optical centre of the object- glass to the centre of eye piece.



Vertical Axis :

It is the axis about which the telescope can be rotated in the horizontal plane.

Horizontal Axis :

It is the axis about which the telescope can be rotated in the vertical plane.

Transit :

It the operation of revolving the telescope through 180 deg. in a vertical plane about the horizontal axis This operation is also called as plunging or reversing.

ADJUSTMENT OF A THEODOLITE :

1. Permanent Adjustments.
2. Temporary Adjustments.

Permanent adjustments :

The permanent adjustments are made to establish the relationship between the fundamental lines of the theodolite and , once made , they last for a long time. They are essential for the accuracy of observations.

The permanent adjustments in case of a transit theodolites are :

i) Adjustment of Horizontal Plate Levels. : The axis of the plate levels must be perpendicular to the vertical axis.

ii) Collimation Adjustment. : The line of collimation should coincide with the axis of the telescope and the axis of the objective slide and should be at right angles to the horizontal axis.

iii) Horizontal axis adjustment. : The horizontal axis must be perpendicular to the vertical axis.

The temporary adjustments :

The temporary adjustments are made at each set up of the instrument before we start taking observations with the instrument. There are three temporary adjustments of a theodolite:

i) Centering. ii) Levelling. iii) Focussing.

MEASUREMENT OF HORIZONTAL ANGLES :

1. Ordinary Method.
2. Repetition Method.
3. Reiteration Method

READING MAGNETIC BEARING OF A LINE :

To find the bearing of a line AB as shown in fig .below

i) Set up the instrument over A and level it accurately

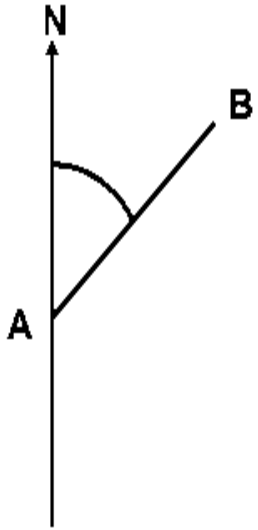
ii) Set the vernier to the zero of the horizontal circle.

iii) Release the magnetic needle and loosen the ….. lower clamp.

iv) Rotate the instrument till magnetic needle points to North. Now clamp the lower clamp with the help of lower tangent screw .Bring the needle exactly against the mark in order to bring it in magnetic meridian. At this stage the line of sight will also be in magnetic meridian.

v) Now loose the upper clamp and point the telescope towards B .With the help of upper tangent screw ,bisect B accurately and read both the verniers .The mean of the two readings will be recorded as magnetic bearing of line.

vi) Change the face of the instrument for accurate magnetic bearing of the line and repeat .the mean of the two values will give the correct bearing of the line AB.



PROLONGING A STRAIGHT A LINE :

There are two methods of prolonging

(1) Fore sight method

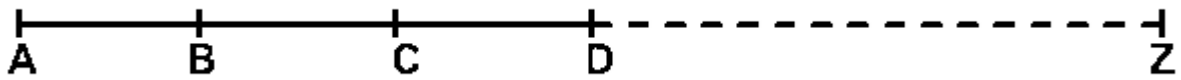
(2) Back Sight Method

(1)Fore Sight Method :

i) Set up the theodolite at A and level it accurately .Bisect the point b correctly. Establish a point C in the line beyond B approximately by looking over the top of the telescope and accurately by sighting through the telescope.

ii) Shift the instrument to B ,take a fore sight on C and establish a point D in line beyond C.

iii) Repeat the process until the last point Z is reached.



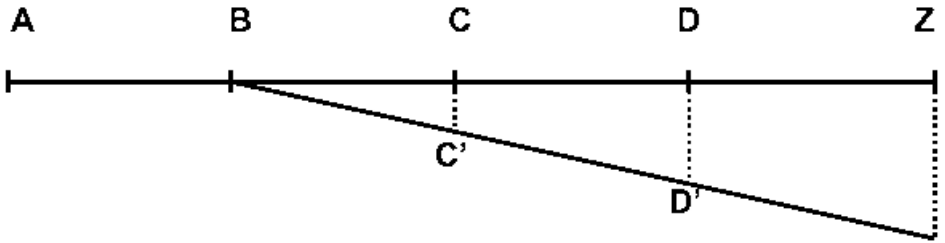
(2) Back Sight Method :

i) Set up the instrument at B and level it accurately .

ii) Take a back sight on A.

iii) Tighten the upper and lower clamps, transit the telescope and establish a point C in the line beyond B.

iv) Shift the theodolite to C ,back sight on B transit the telescope and establish a point D in line beyond C. Repeat the process until the last point (Z) is established.



Vertical Angle:

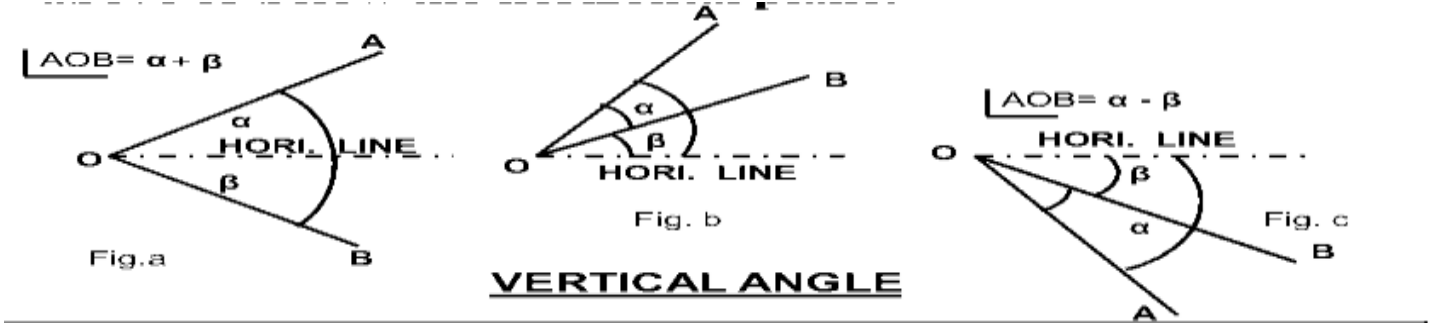
A vertical angle is an angle between the inclined line of sight and the horizontal. It may be an angle of elevation or depression according as the object is above or below the horizontal plane.

For measuring Vertical Angle between two points

i) A & B Sight A as before , and take the mean of the two vernier readings at the vertical circle. Let it be α

ii) Similarly, sight B and take the mean of the two vernier readings at the vertical circle. Let it be β

iii) The sum or difference of these dings will give the value of the vertical angle between A and B according as one of the points is above and the other below the horizontal plane. or both points are on the same side of the horizontal plane Fig b & c



VERTICAL ANGLE

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